Rhode Island Flood Plain Management Services

Dam-Break Flood Analysis
Greenwich Bleachery Pond Dam
East Greenwich, Rhode Island

March 1996

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of Engineers
New England Division

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The purpose of this study was to determine the downstream hazard potential of the Bleachery Pond Dam, East Greenwich, Rhode Island. The work was completed for the Rhode Island Department of Environmental Management Dam Safety Program. Various dam-break flood conditions were modeled and inundation maps developed. Based on this analysis the dam is rated a Class 2 or SIGNIFICANT hazard category in terms of its potential to cause downstream damage. Introductory information was also included to aid in the development of an Emergency Plan in the event of an impending dam failure.

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GREENWICH BLEACHERY POND DAM
EAST GREENWICH, RHODE ISLAND

DAM-BREAK
FLOOD ANALYSIS

PREPARED FOR
STATE OF RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
DAM SAFETY PROGRAM

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GREENWICH BLEACHERY POND DAM
DAM-BREAK FLOOD ANALYSIS

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GREENWICH BLEACHERY POND DAM
DAM-BREAK FLOOD ANALYSIS

EXECUTIVE SUMMARY

The primary purpose of this study is to determine the downstream hazard classification of Greenwich Bleachery Pond Dam for the Dam Safety Program under jurisdiction of the State of Rhode Island, Department of Environmental Management. The secondary purpose is to provide introductory information to assist the dam owner in developing an Emergency Action Plan (EAP) in the event of an impending dam failure.

Dam-break flood conditions are evaluated for both sunny-day and storm-day failures. The analyzed storm event consists of the 100-year recurrent storm. Peak inflows and the spillway hydraulic capacity are developed as a basis upon which to model the breach discharge. Peak flows are routed through the reservoir using the National Weather Service (NWS) DAMBRK flood forecasting model. Breach discharge hydrographs for a sunny-day and storm-day are routed through the downstream channel for a distance of approximately one half mile below the dam. Limits of inundation are delineated in plan and profile view.

On the basis of U.S. Army Corps of Engineers guidelines for safety inspection, the dam's size classification is SMALL. On the basis of its potential to cause downstream damage, in terms of either loss of life or economic loss, Greenwich Bleachery Pond Dam is rated Class 2 or a SIGNIFICANT hazard category.

Four major components of an EAP are discussed: monitoring, evaluation, preventive action, and warning. Official contacts are provided in the event of an impending dam failure.

GREENWICH BLEACHERY POND DAM
DAM-BREAK FLOOD ANALYSIS

1. INTRODUCTION

a. Purpose. This study was conducted to define the magnitude and extent of downstream flooding effects and to determine the hazard classification of the Greenwich Bleachery Pond Dam for the State of Rhode Island, Department of Environmental Management, Dam Safety Program. A secondary purpose is to provide information for use by the dam owner in developing an Emergency Action Plan (EAP) in the event of an impending dam failure.

The study provides findings for various assumed dam-break flood conditions for the Greenwich Bleachery Pond Dam with resulting downstream effects. Findings include development of storm inflows into the dam, mechanisms which trigger the failure of the dam, resulting breach discharges, and delineation of downstream flooded area and hazard classification. This study investigated the results of a hypothetical dam-break at Bleachery Pond, and was not performed because of any expected failure of the dam.

b. Authority. This study was performed by the Corps of Engineers under Section 206 Flood Plain Management Services (FPMS) Program, at the request of the State of Rhode Island, Department of Environmental Management.

c. Downstream Hazard Classification. Dams are classified according to the potential for loss of life and property damage in the areas downstream of a dam if it were to fail. The hazard classification does not refer to the condition of the dam.

The classification system used in this study has been adopted by the U.S. Army Corps of Engineers and is used by the Department of Environmental Management to determine inspection frequency and spillway adequacy for dams under its jurisdiction. The hazard classifications follow:

DOWNSTREAM HAZARD CLASSIFICATION OF DAMS

Class	Potential Hazard Category	Loss of Life (Extent of Development)	Potential Economic Loss (Extent of Development)
3	Low	None Expected (No permanent structure for human habitation)	Minimal (Undeveloped, occasional structures or agriculture)
2	Significant	Few (No urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry, or structures)
1	High	More than a few	Excessive (Extensive community, industry, or agriculture)

Under the Corps' system, the classifications are further described as follows:

(1) LOW Hazard (Class 3). Dams conforming to criteria for the low hazard potential category generally will be located in rural or agricultural areas where failure may damage farm buildings, limited agricultural land, or township and country roads.

(2) SIGNIFICANT Hazard (Class 2). Significant potential hazard category structures will be those located in predominantly rural or agricultural areas where failure may damage isolated homes, secondary highways or minor railroads or cause interruption of use or service of relatively important public utilities.

(3) HIGH Hazard (Class 1). Dams in the high hazard potential category will be those where failure may cause serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways or railroads.

In addition, it is important to understand the following:

(1) The terminology HIGH, SIGNIFICANT, AND LOW hazard refers to the potential for damage or loss of life and does not refer to the condition of the dam. For example, a HIGH hazard

(Class 1) dam may be in excellent condition and a LOW hazard (Class 3) dam may be in poor condition.

(2) A dam's classification may change from initial assessment or from the last inspection because of changes in downstream conditions. For example, a Class 3 (low hazard) dam may become a Class 2 (significant hazard) or Class 1 (high hazard) dam if some houses are built downstream that could be impacted by a failure. The classification could also change (either up or down) if a more detailed breach analysis is carried out that more accurately determines downstream damage potential.

(3) It should not be assumed that the failure of a Class 3 (low hazard) dam would never be a threat to life. Although direct loss of life (such as by flooding a house) is not expected, the failure could for example, wash out a road and result in a fatal accident.

2. PROJECT DESCRIPTION

a. General. Greenwich Bleachery Pond Dam is located approximately 2,600 feet upstream from the mouth of the Maskerchugg River at Greenwich Cove in the town of East Greenwich, Kent County, Rhode Island (see plate 1). The dam was originally built for power generation; however, the plant and its equipment have since been removed. At present, the dam is used to maintain a recreational pool. The dam is an earth-masonry gravity dam and has an overall crest length of 350 feet at elevation 33.5 feet NGVD with a 75-foot long uncontrolled spillway crest at elevation 31.5 feet NGVD. The structure has a sluice gate which is operable, though permanently closed.

b. Community Description. The town of East Greenwich is located in the center of Rhode Island, approximately 15 miles south of Providence. It is bordered by the town of West Warwick and city of Warwick to the north and the town of North Kingstown to the south. Manufacturing and wholesale and retail trade are the leading industries in East Greenwich.

c. Downstream Conditions. The area investigated for flooding potential is along the Maskerchugg River downstream of Bleachery Pond Dam. Channel bottom elevation downstream of the dam is about 14.4 feet NGVD and drops to elevation 0.0 feet NGVD at its confluence with Greenwich Cove. The flood plain is not developed. Discharges from the Maskerchugg River flow through a narrow channel with varying slopes which at some locations are as high as 70.0 feet/mile. The reach is approximately 2,600 feet in length.

Downstream of the dam the Maskerchugg River passes under two bridges. The first bridge, Boston Post Road - Route 1, has a horseshoe-shaped culvert with a width of approximately 16 feet, and is located just 900 feet downstream of the dam. At this point the stream invert elevation is 5.2 feet NGVD. Route 1 is a four-lane road that provides major access to the town of East Greenwich from the south. The top of road elevation at the crossing of the Maskerchugg River is approximately 20.8 feet NGVD. Examination of the Flood Insurance Study (FIS) flood profiles show that overtopping of this bridge does not occur until a 500-year event. For the dam break analysis a cross section of the 16-foot horseshoe culvert was used in the model, with the top of the section extending above top of road elevation. Therefore, the model routes all of the dam-break discharge through the culvert.

The only building downstream of the dam is an office/retail building, located immediately downstream of the Route 1 crossing. However, the first floor elevation was approximately 20.0 feet NGVD, a considerable distance above the 100-year flood plain.

A second bridge (Conrail bridge) is located 1,700 feet from the dam and just 1,000 feet from the mouth of the Maskerchugg River at the cove. Invert elevation at this bridge is approximately 1.5 feet NGVD. The culvert at the Conrail bridge is about 20 feet wide. Overtopping of this bridge does not seem probable since the elevation of the railroad is at 34.2 feet-NGVD.

3. DAM DESCRIPTION (DATA TAKEN FROM THE RHODE ISLAND INVENTORY OF DAMS)

a. Identification. The national inventory prepared by the U.S. Army Corps of Engineers identifies this impoundment as RI04105. The structure is owned by the State of Rhode Island, Department of Environmental Management, Division of Parks and Recreation (DEM-DIV of P&R).

b. Physical Characteristics.

Type:	Earth Masonry
Length:	Approximately 350 feet
Height:	Approximately 18 feet
Top Width:	Varies

c. Outlets. A gate remains from the hydropower operations; however, no information exists on dimensions and location of this gate, but according to town officials the gate is permanently closed.

d. Impoundment Behind Dam

Surface Area:	6 acres
Height of Dam:	18 feet at crest
	16 feet at spillway

Estimated storage volume:

	48 acre-feet at normal elevation
	60 acre-feet at top of dam

e. Pertinent Elevations

Top of Dam:	33.5 ft-NGVD
Spillway:	31.5 ft-NGVD
Upstream Invert Centerline of Dam	15.5 ft-NGVD

f. Watershed Area

Size:	5.6 square miles (from USGS topographic quadrangles)
Type:	Moderately urbanized with mild slopes

4. METHOD OF ANALYSIS

a. Introduction. Two types of dam failure simulations were conducted for this study: sunny-day and storm-day failures.

A sunny-day failure refers to a failure under normal water level usually associated with fair weather or non-flood conditions. It often results from piping, which is the progressive internal erosion of a soil mass such as an embankment, foundation or abutment of a dam from uncontrolled seepage carrying soil particles to an unprotected exit that over time creates an erosion cavity or pipe. Once this happens, a rapid failure of the dam can occur which releases the contents of the reservoir and forms the breach discharge. Piping is the most common cause of sunny-day failures of earth dams. A sunny-day failure can also result from other causes, such as a sudden failure of a conduit under pressure or a structural component of the dam.

A storm-day failure is associated with major storm events and floods. During periods of significant rainfall and resulting runoff, the lake will rise to high levels. If a storm is severe enough, and the inflow exceeds the hydraulic capacity of the spillway and reservoir storage capacity, overtopping of the embankment can occur. As flood waters flow over the dam, the erosion of the earth embankment or abutments can occur resulting in a failure of the dam and the formation of the breach discharge as the contents of the reservoir are released. High reservoir levels associated with overtopping of the dam, can also result in other failure modes, such as piping, sudden structural failure or progressive failure of stone or masonry elements.

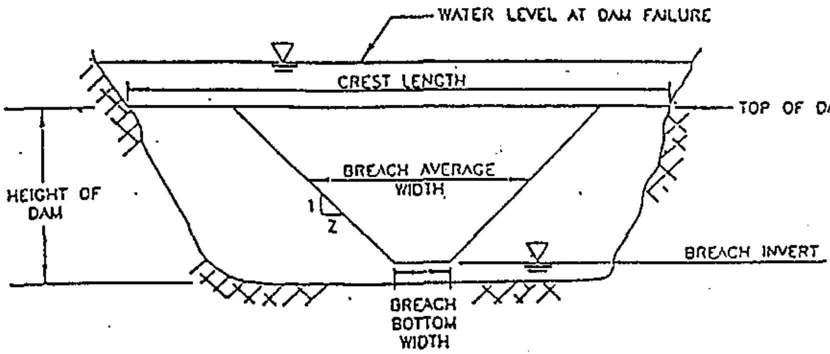
b. Hydrology. After discussions with the State, the 100-year storm was adopted as a reasonable storm day scenario. To accomplish dam-break analyses, a peak inflow to the reservoir resulting from the storm day scenario was developed.

Peak discharge for the 100-year flood event was derived using data from the USGS gage on the Hunt River, a watershed of similar characteristics, located nearby. Peak annual flows, recorded for the Hunt River since 1942 to the present, were analyzed in a Log-Pearson Type III distribution to determine discharge frequencies. Values applicable to the Maskerchugg River were derived using the drainage area ratio method applied to computed flows at the Hunt River gage. The findings were then confirmed using regression equations developed by the USGS for Rhode Island and Massachusetts. The derived discharges were in close agreement to the regression equation values. The developed 100-year discharge (500 cfs) was compared to the 100-year discharge reported in the 1982 FIS. This FIS lists a 100-year peak flow of 2,035 cfs and states that it was computed with a Soil Conservation Service Watershed model for an earlier FIS completed in 1972. We attempted to resolve the 2,035 versus 500 cfs question by searching background information, but were unable to obtain any information concerning the watershed model developed for the original FIS. Therefore, we compared the FIS discharge to the computed discharge based on the Hunt River gaged data and the size of the watershed (5.6 square miles). Comparing this information we made an engineering judgement that for the purpose of this study we would adopt the lower 100-year discharge based on the Hunt River data. This was considered appropriate since the purpose of this study is to determine hazard and inundation limits for a dam-break of Bleachery Pond Dam associated with a reasonably high inflow flood event.

Due to the proximity of the dam to Greenwich Cove, tide levels were also considered to play a part in the analysis. The storm-day failure was analyzed assuming a 100-year tide elevation of 14.0 feet NGVD. We recognize that a coincidental 100-year flood event with a 100-year tide is a conservative approach. The sunny-day scenario on the other hand was analyzed assuming a mean tide level of 2.9 feet NGVD. These two scenarios provide a good range of flooding information for the study area.

c. Spillway Hydraulic Capacity. A rating curve for the Greenwich Bleachery Pond Dam was developed based on the geometry of the spillway and dam. Approximate geometry of the non-overflow sections at the east and west abutments was determined using 5-foot contour mapping for pool levels greater than top of dam elevation, 33.5 feet NGVD. Flows through the gate were considered negligible since this gate is reportedly permanently closed.

d. Breach Discharge Hydrograph. The discharge hydrograph of a breach is a function of the inflow hydrograph and breach parameters (time of breach formation, size and shape of breach) of a hypothetical dam failure. The following sketch illustrates the various dam breach parameters for a typical earthen or concrete gravity dam. Total outflow is a combination of flows throughout the breach and spillway. As the breach develops, so does the breach discharge.



DEFINITION SKETCH OF BREACH PARAMETERS

e. Assumed Breach Parameters

Assumed Sunny-Day Failure Condition

Initial Pool Level: Spillway crest 31.5 feet NGVD

Dam Failure Level: El. 31.5 feet NGVD

Breach Invert: 17.0 feet NGVD

Breach Bottom Width: 50 feet with side slope 1V:0H

Time to complete formation of Breach: 0.3 hour

Downstream Reach Roughness (Manning's "n" Values):
Channel = 0.035 to 0.08
Overbank = 0.08 to 0.10

Embankment Geometry:
Height of Dam = 16 feet at spillway
18 feet at top of dam

Crest Length = spillway = 75 feet
top of dam = 350 feet

Assumed Storm-Day Failure Condition

Initial Pool Level: El. 33 feet NGVD

Dam Failure Level: El. 33.5 feet NGVD

Breach Invert: El. 17.0 feet NGVD

Breach Bottom Width: 50 feet with side slope 1V:0H

Time to Complete Formation of Breach: 0.6 hour

Downstream Reach Roughness (Manning's "n" Values):

Channel = 0.035 to 0.08

Overbank = 0.08 to 0.10

Embankment Geometry:
Height of Dam = 16 feet at spillway
18 feet at top of dam

Crest Length = spillway = 75 feet
top of dam = 350 feet

f. Downstream Channel Routing. A downstream channel routing analysis allows the breach discharge hydrograph to be characterized at points of interest below the dam. A breach hydrograph is attenuated and stored through a downstream channel and flood plain in a manner similar to that where an inflow hydrograph is routed through a reservoir. The degree to which this breach discharge is attenuated is a function of the downstream valley storage capacity and valley roughness characteristics.

The dynamic wave method of channel routing is used in the NWS DAMBRK computer program to route the flood wave downstream. This is a hydraulic routing method that solves the complete unsteady flow equations through a given reach. Results of this method indicate attenuation of the flood wave, resulting flood stages, and the time it takes the wave to reach the section.

Downstream valley storage was determined by cross sections developed using 5-foot contour mapping provided by town planning officials and USGS topographic quadrangles. Based on field observations, assigned Manning's "n" values ranged between 0.035 and 0.08 for channel, and 0.08 and 0.1 for overbanks.

The downstream channel routing procedure is based on the assumption that flow structures below the dam (i.e., Route 1, Conrail) do not become blocked with debris. The hydraulic rating data for these structures assumes full hydraulic capacity. If structures become blocked with debris, the peak water surface elevation behind them could increase to stages higher than estimated.

In addition, all flow structures were assumed not to fail in the dam-break computer model in order to estimate the maximum water levels expected. However, due to the increased flood stages and velocities associated with a dambreak, failure of any or all these structures is possible. This study does not attempt to determine if any downstream structures will fail during a dam-break at Bleachery Pond Dam.

In order for the NWS DAMBRK model to mathematically converge on initial (antecedent) conditions, a minimum amount of flow is required. The initial channel flow for the sunny-day condition was assumed to be 15 cfs. This was the minimum flow for which the program converged. Based on water resource data supplied by the USGS, the mean annual runoff for this region of the country is approximately 1.8 cfs/square mile of drainage area, so the estimated mean annual flow for the Maskerchugg River is approximately 10 cfs.

For storm-day routing, initial flows were those associated with the storm-day flood hydrograph just prior to dam failure. The dam was assumed to fail at the peak elevation and outflow for the 100-year flood event.

g. Project Mapping. Maps used for this study were the East Greenwich, R.I. scale 1:24000 USGS map , 7.5 minute series topographic quadrangle (photo-revised 1970 and 1975) and a 5 foot contour map, scale 1" = 200' provided by town officials.

Location of structures within inundation limits were verified through field visits, site reconnaissance, and FIS information for the town of East Greenwich, Kent County, Rhode Island.

5. RESULTS OF ANALYSIS

a. Inflow Hydrograph. Inflow peak for the 100-year event (Storm-day hydrograph) was determined to be 500 cfs. This hydrograph was developed using regional frequency analysis.

b. Reservoir Storage Capacity. An area capacity curve for Bleachery Pond was developed using information provided by State and town officials. The maximum storage capacity at the top of dam, elevation 33.5 feet NGVD is approximately 60 acre-feet, and the storage capacity at the recreation pool elevation of 31.5 is approximately 40 acre-feet. These values were obtained from the

Rhode Island Dam inventory sheet. As determined from the 100-year inflow hydrograph analysis, 60 acre-feet are stored behind the dam so that the resulting maximum stage under this storm event is 33.5 feet NGVD.

c. Spillway Hydraulic Capacity. Maximum spillway hydraulic capacity at the top of the dam is approximately 860 cfs, which represents flow over the spillway only. Bleachery Pond Dam appears to have sufficient spillway capacity and adequate storage to route and pass the computed 100-year flood without overtopping the dam.

d. Breach Discharge Hydrograph. Tables 1 and 2 summarize the peak discharge and downstream channel routing results assuming sunny- and storm-day failures, respectively.

Sunny-day failure of Bleachery Pond Dam resulted in a peak breach discharge of approximately 1,510 cfs. The assumed water surface was at elevation 31.5 feet NGVD when failure began, and the breach was modeled to develop fully within 18 minutes. Plates 2 and 3 show sunny-day breach discharges and flow depth hydrographs at several downstream locations.

Storm-day failure results in a peak breach discharge of about 2,380 cfs with the 100-year storm initial inflow. Failure is modeled to begin at the peak of the inflow hydrograph, which corresponds to an elevation of 33.5 feet NGVD and the breach is assumed to develop within 36 minutes. Plates 4 and 5 show the storm-day discharge and flow depth hydrograph at several downstream locations.

6. DOWNSTREAM CHANNEL ROUTING

Plate 6 shows peak water surface profiles resulting from both the sunny and storm-day failure scenario.

a. Sunny-Day Results. The sunny-day peak breach discharge is estimated by the DAMBRK model to be 1,510 cfs with resulting estimated elevation of 14.1 feet NGVD upstream of Route 1 and 7.9 feet NGVD upstream of Conrail bridge.

Discharge attenuated from 1,510 cfs at the dam to 1,280 cfs at Route 1. Little attenuation through the remaining portion of the reach occurs. At the mouth of Greenwich Cove the discharge was determined to be approximately 1,260 cfs. Elevation of the office/retail building downstream of Route 1 is higher than the peak flood elevations; therefore, the dam break model predicts that this location will not be flooded.

b. <u>Storm-Day Results</u>. The storm-day peak breach discharge of 2,380 cfs, estimated by the model, is attenuated in the first 0.17 mile to 1,400 cfs. The stage upstream of Route 1 bridge is 20 feet NGVD, about six feet higher than that for the sunny-day failure. The large difference in stage levels for the two simulations is mostly due to tide level which were assumed to be 14.0 and 2.9 feet-NGVD for storm-day and sunny-day simulations, respectively.

7. INUNDATION MAPPING

The limits of inundation were computed by routing the breach discharge hydrograph through the downstream valley cross sections and delineating the resulting maximum stages on the base map. The map used is based on a 5-foot contour interval and, therefore, inundation limits shown on plates 7 and 8 are only approximate. Only one structure is located near these limits and not expected to be inundated by the sunny or storm-day failures.

TABLE 1

<u>Greenwich Bleachery Pond Dam</u>
<u>East Greenwich, R.I.</u>

<u>Downstream Channel Routing Results</u>
<u>Sunny-Day Failure</u>

Downstream Location	Peak Discharge (cfs)	Elevation (ft-NGVD)	Depth Above Streambed (ft)	Time to Peak (hours)
Bleachery Pond Dam (0.0 mi.)	1,510	32.8	17.3	.3
U/S Route 1 (0.17 mi.)	1,280	14.1 *	9.1	.4
U.S/ Conrail (0.31 mi.)	1,260	7.9 *	6.4	.5

* Stages influenced by tide level (2.9 ft-NGVD).

TABLE 2

Greenwich Bleachery Pond Dam
East Greenwich, R.I.

Downstream Channel Routing Results
Storm-Day Failure

Downstream Location	Peak Discharge (cfs)	Elevation (ft-NGVD)	Depth Above Streambed (ft)	Time to Peak (hours)
Bleachery Pond Dam (0.00 mi.)	2,380	33.5	18.0	.6
U/S Route 1 (0.17 mi.)	1,400	20.0 *	15.3	.7
U/S Conrail (0.31 mi.)	1,220	15.5 *	14.2	.8

* Stages influenced by tide level (14.0 ft-NGVD).

8. SIZE CLASSIFICATION

The Bleachery Pond Dam is approximately 18 feet high from top of the dam to the streambed invert elevation. The maximum available storage with the pool at the top of the dam is approximately 60 acre-feet based on height; the dam is considered "SMALL" according to paragraph 2.1.1 of the Recommended Guidelines for Safety Inspection of Dams.

9. HAZARD CLASSIFICATION

Since there are no residences and little loss of life potential downstream of the Bleachery Pond Dam, it could be expected to give a classification level of 3 or "LOW" category. However, the location of the dam in a moderately urbanized area, the presence of the Route 1 crossing, a major highway and access road to the city of East Greenwich and of the Conrail Railroad Bridge, an important structure, leads us more into giving the Bleachery Pond Dam a Level 2 or "SIGNIFICANT" category. This is mainly attributable to potential damage to these major transportation facilities. Refer to the Downstream Hazard Classification of Dams on page 2 of this report.

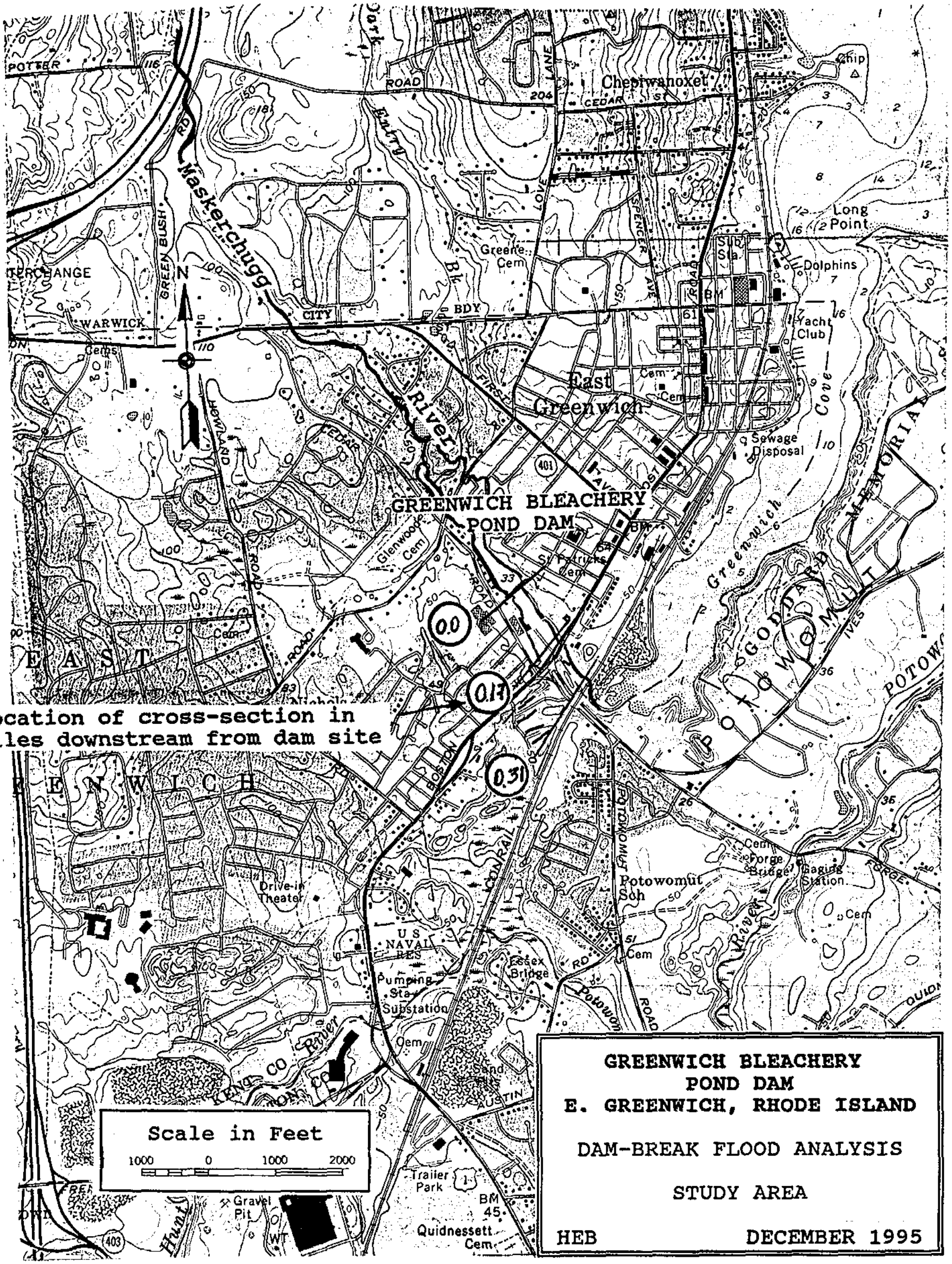

GREENWICH BLEACHERY
POND DAM
E. GREENWICH, RHODE ISLAND
DAM-BREAK FLOOD ANALYSIS
STUDY AREA
HEB
DECEMBER 1995
Scale in Feet
1000 0 1000 2000
GREENWICH BLEACHERY
POND DAM
Location of cross-section in
miles downstream from dam site
0.0
0.17
0.31
N
Maskerchugg
River
East
Greenwich
Chepiwanoxet
Long
Point
Dolphins
Yacht
Club
Sewage
Disposal
Greenwich Cove
GODDARD
MEMORIAL
POTOWOMUT
EAST
GREENWICH
WARWICK
CITY
BDY
Glenwood
Cem
St Patricks
Cem
Drive-in
Theater
US
NAVAL
RES
Pumping
Sta
Substation
Potowomut
Sch
Forge
Bridge
Gaging
Station
Essex
Bridge
Trailer
Park
Gravel
Pit
Quidnessett
Cem

PLATE 1

SUNNY-DAY FAILURE

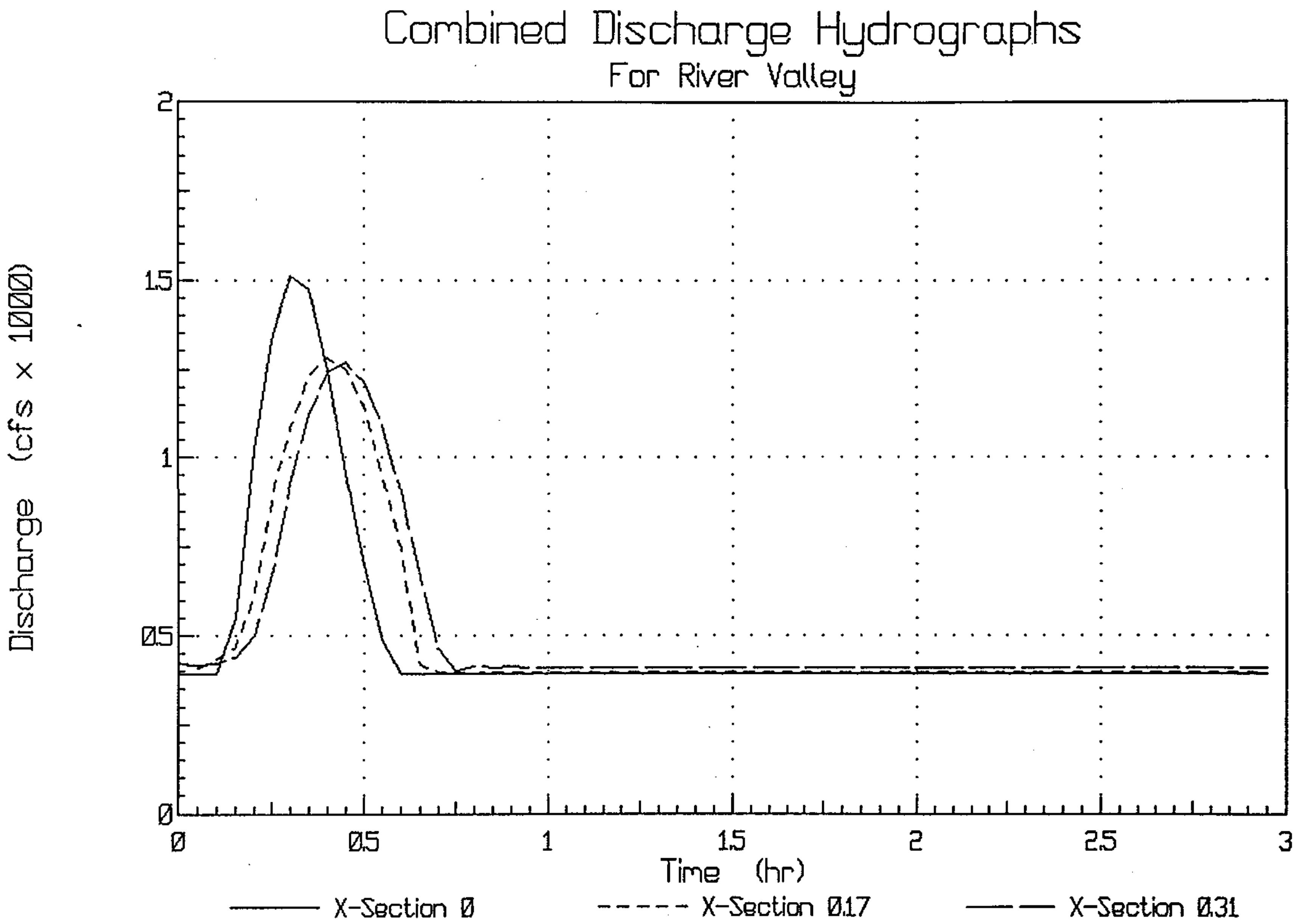


PLATE 2

SUNNY - DAY FAILURE

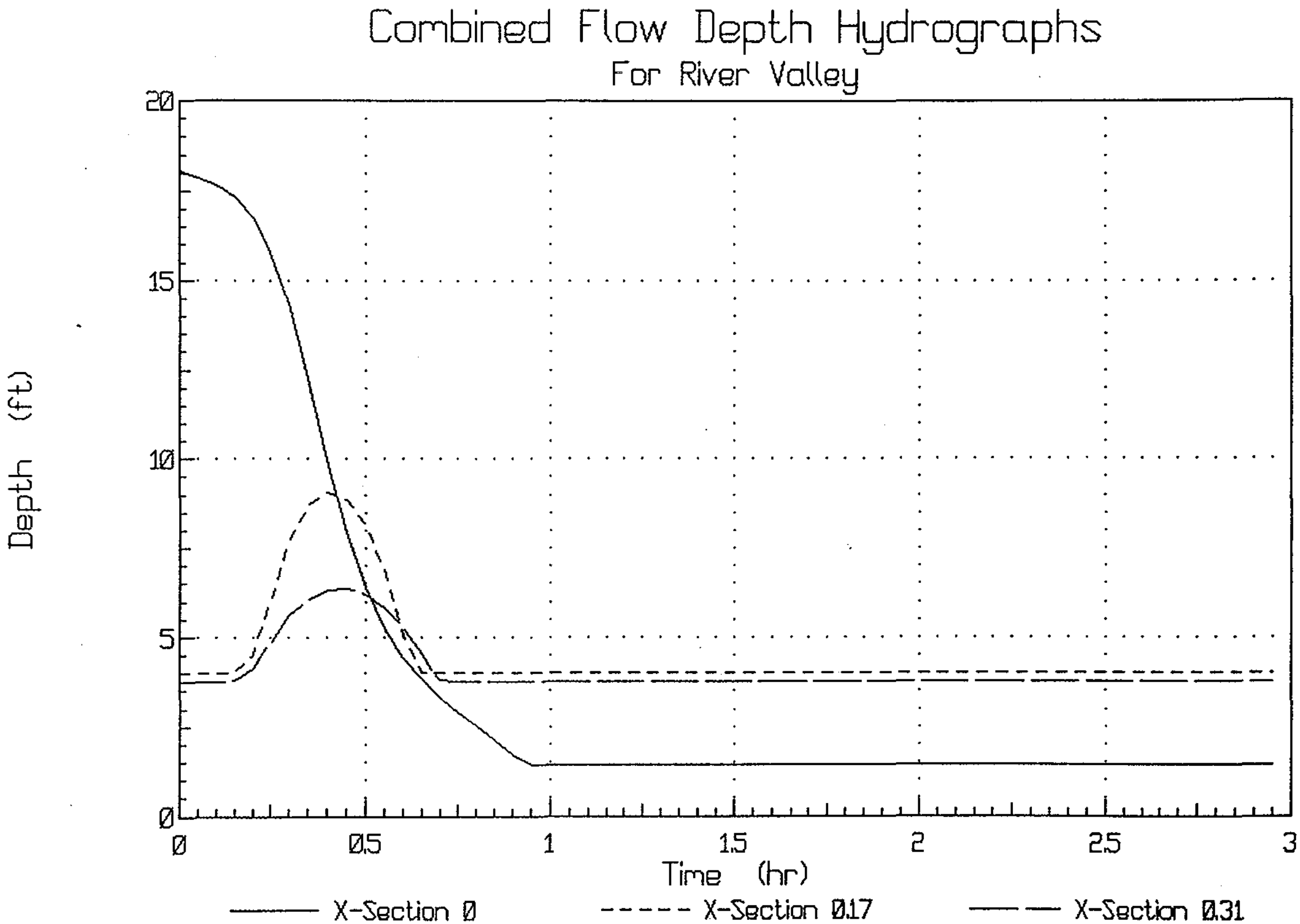


PLATE 3

STORM - DAY FAILURE

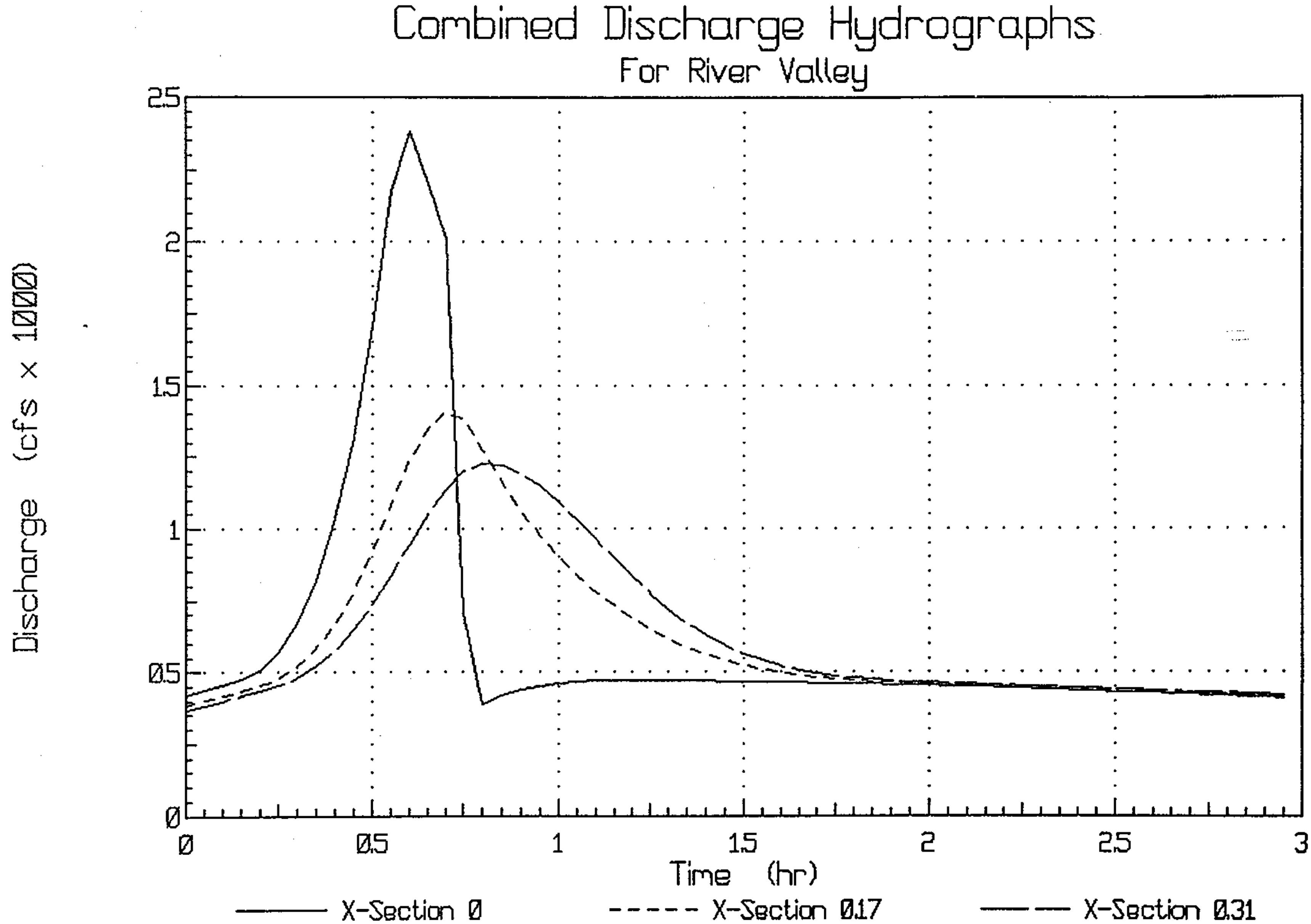


PLATE 4

STORM DAY FAILURE

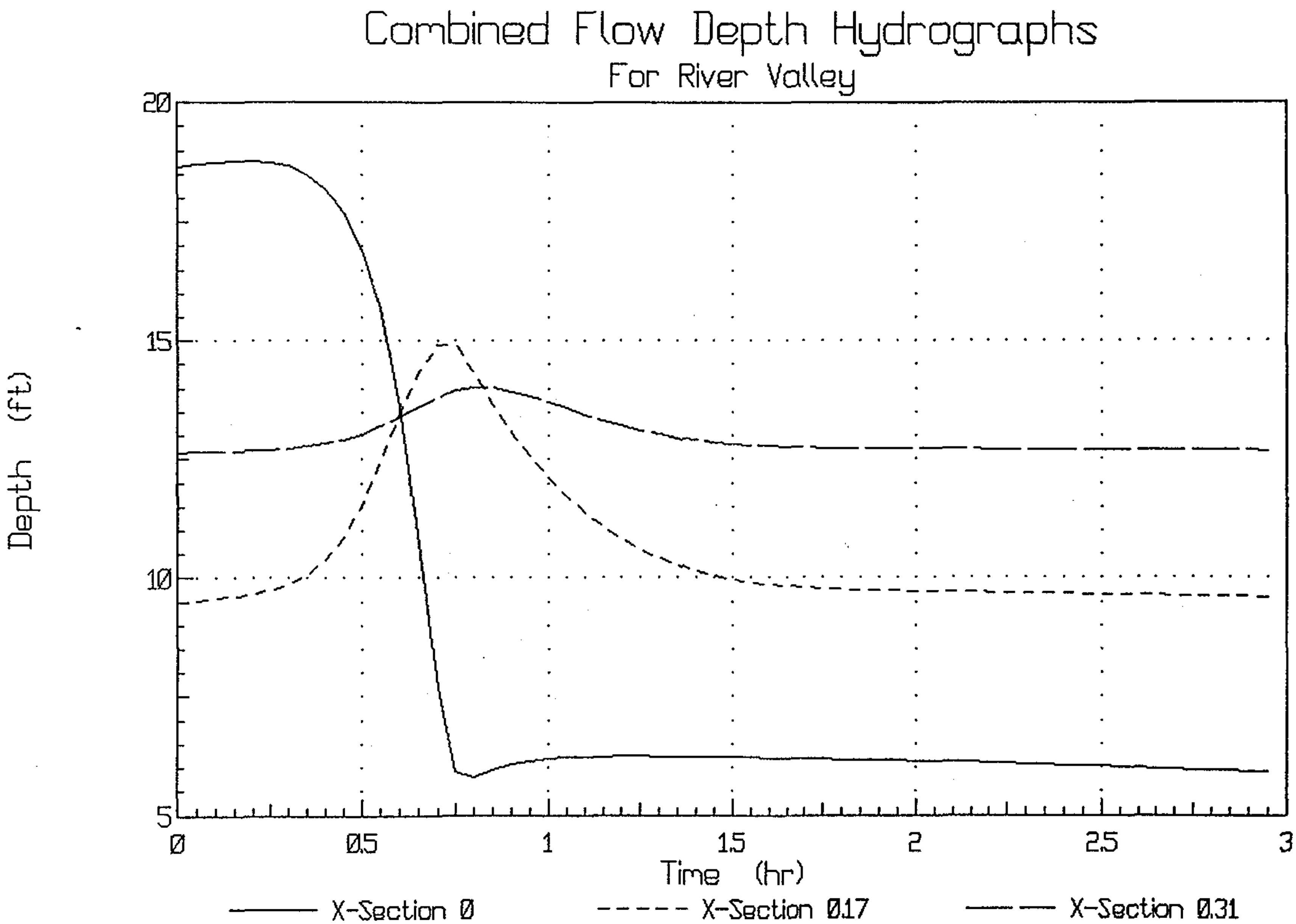


PLATE 5

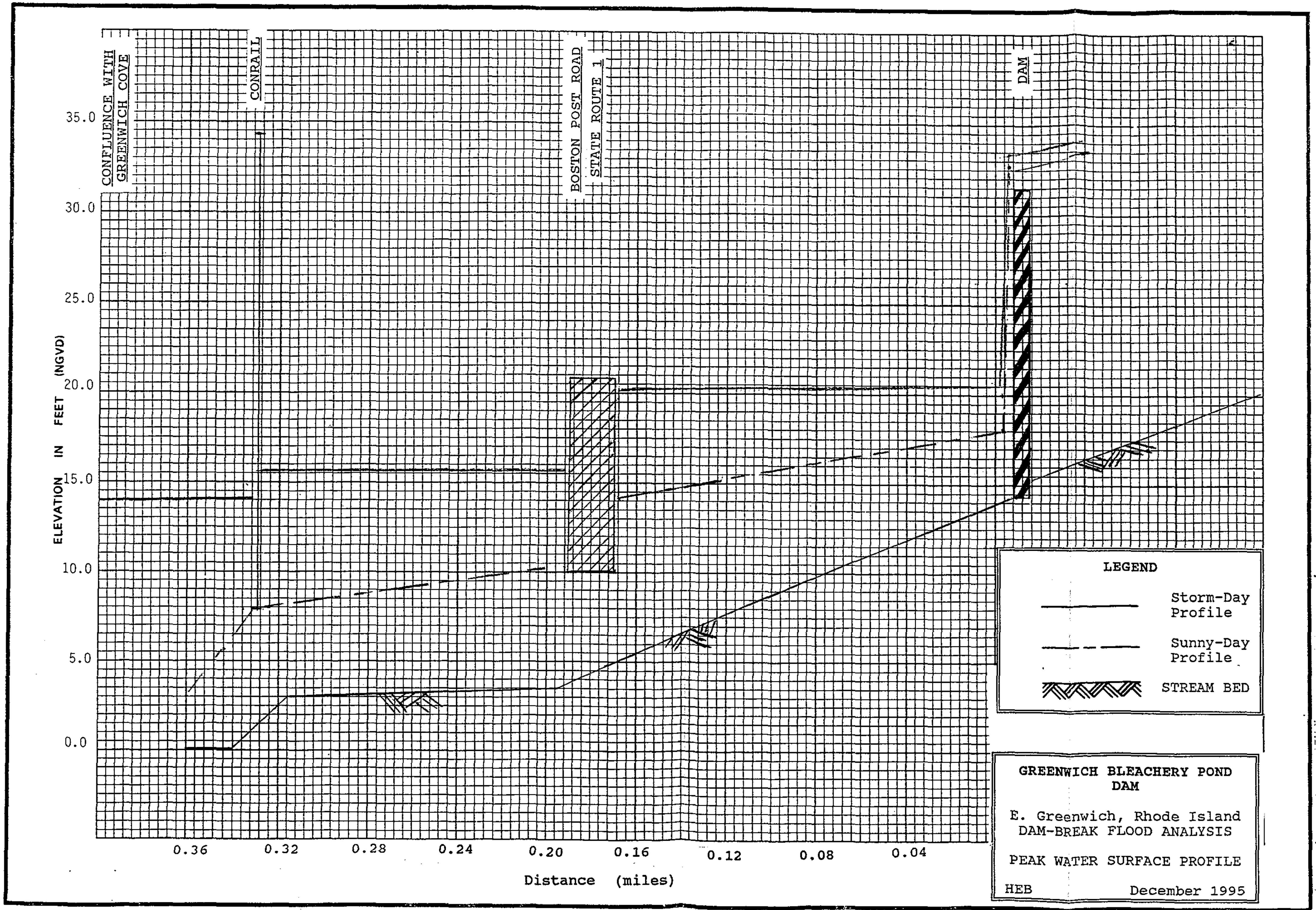

CONFLUENCE WITH GREENWICH COVE
CONRAIL
BOSTON POST ROAD
STATE ROUTE 1
DAM
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
ELEVATION IN FEET (NGVD)
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
Distance (miles)
LEGEND
Storm-Day Profile
Sunny-Day Profile
STREAM BED
GREENWICH BLEACHERY POND DAM
E. Greenwich, Rhode Island
DAM-BREAK FLOOD ANALYSIS
PEAK WATER SURFACE PROFILE
HEB
December 1995

PLATE 6

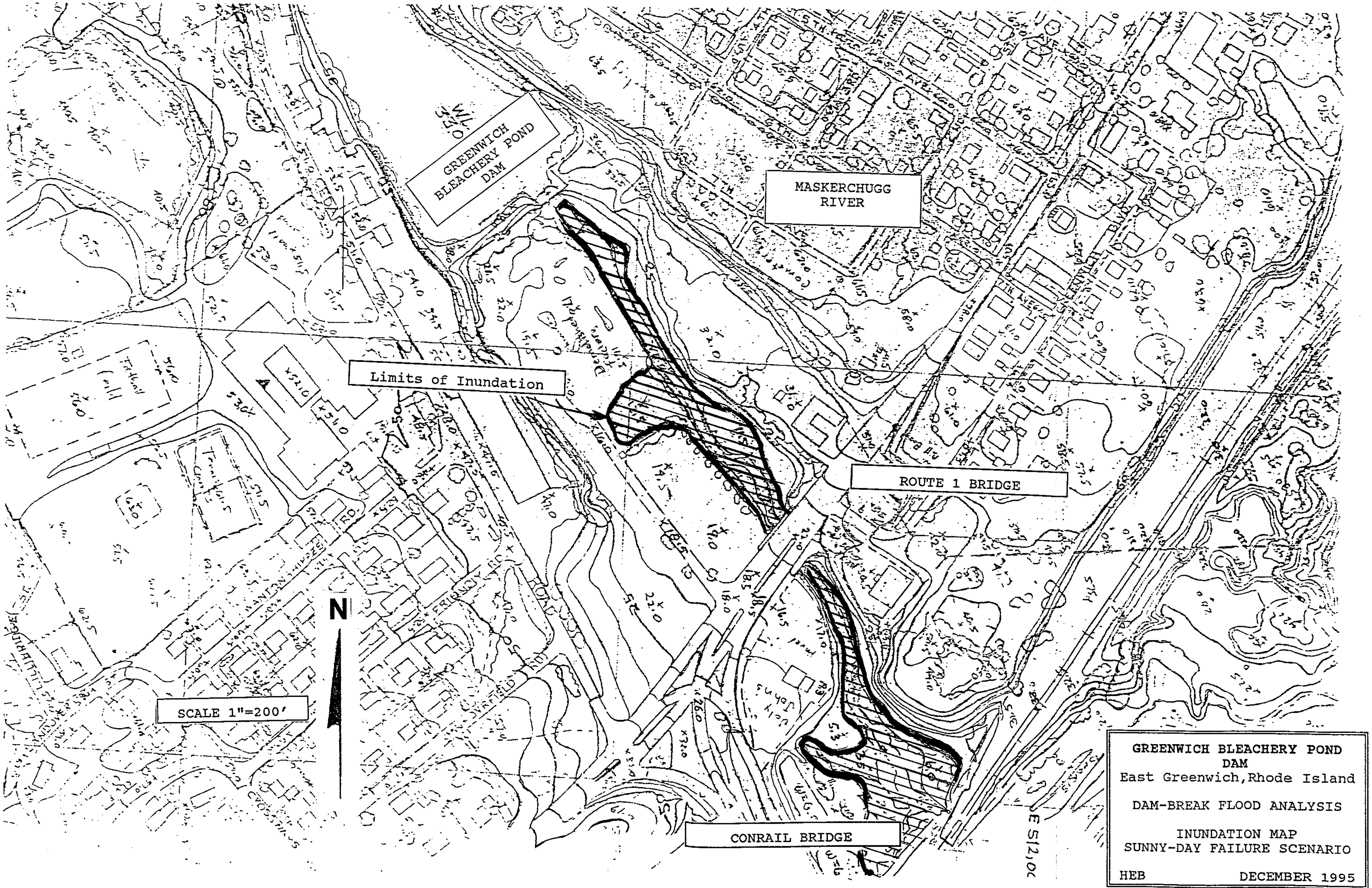

GREENWICH BLEACHERY POND DAM
MASKERCHUGG RIVER
Limits of Inundation
ROUTE 1 BRIDGE
N
SCALE 1"=200'
CONRAIL BRIDGE
GREENWICH BLEACHERY POND DAM
East Greenwich, Rhode Island
DAM-BREAK FLOOD ANALYSIS
INUNDATION MAP
SUNNY-DAY FAILURE SCENARIO
HEB
DECEMBER 1995

PLATE 7

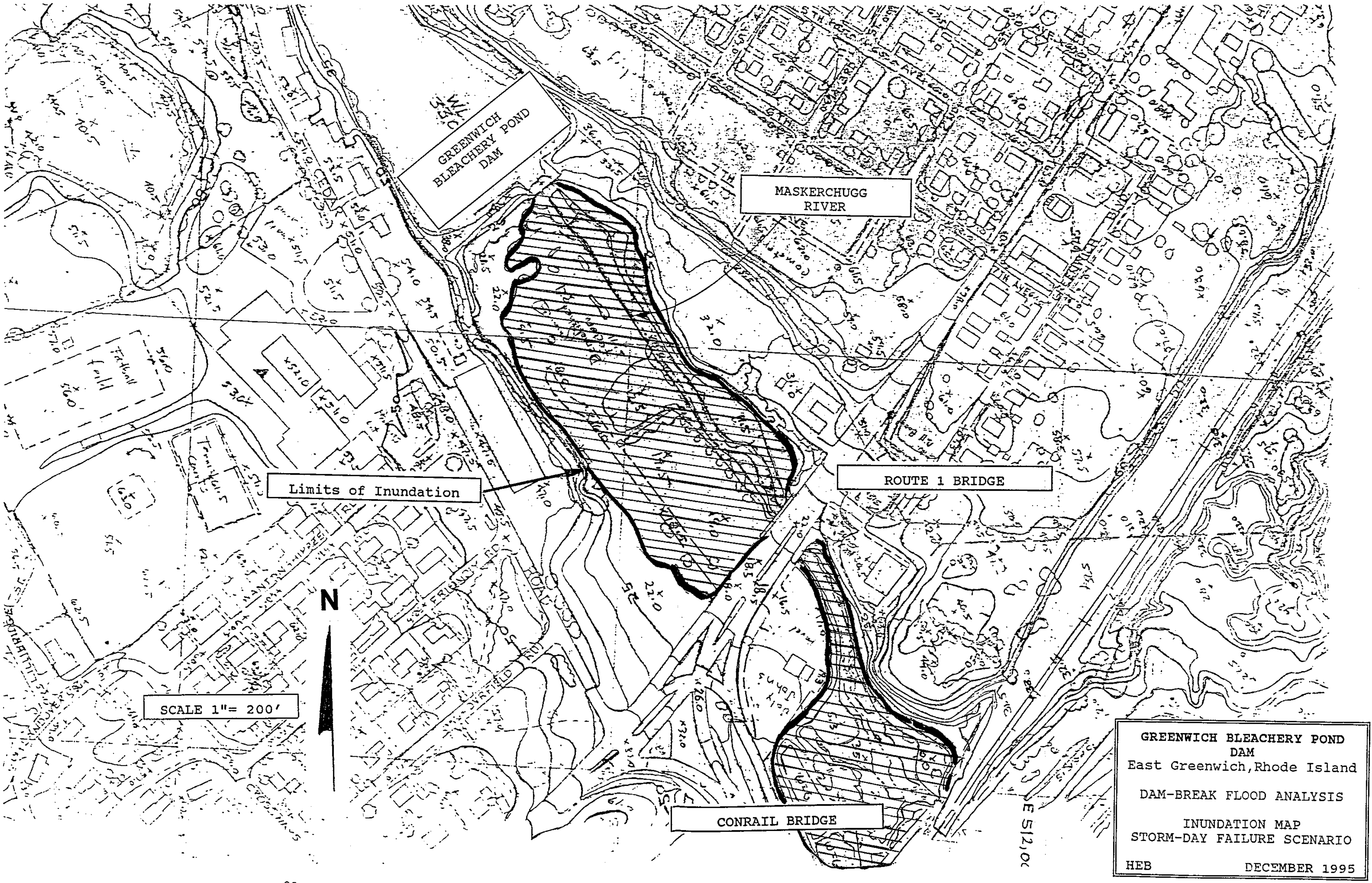

GREENWICH BLEACHERY POND DAM
MASKERCHUGG RIVER
Limits of Inundation
ROUTE 1 BRIDGE
N
SCALE 1"= 200'
CONRAIL BRIDGE
GREENWICH BLEACHERY POND DAM
East Greenwich, Rhode Island
DAM-BREAK FLOOD ANALYSIS
INUNDATION MAP
STORM-DAY FAILURE SCENARIO
HEB
DECEMBER 1995

PLATE 8

EMERGENCY ACTION PLAN FOR GREENWICH BLEACHERY POND DAM

1. INTRODUCTION

a. Purpose. This Emergency Action Plan (EAP) is a suggested procedural outline indicating appropriate steps to be taken in the event of an impending failure of Greenwich Bleachery Pond Dam. This EAP lists phone numbers of certain local and State officials to contact in case of an emergency.

NOTE: The basic outline and Inundation maps in the report can be used by the dam owner in developing a more comprehensive EAP with the involvement of local and State Emergency Management personnel. A more comprehensive EAP would establish additional protocols for monitoring, notification, warning, evacuation and other emergency response measures.

b. Items in the EAP. Following are major items which should be addressed by the owner of the dam:

Monitoring
Evaluation
Prevention
Warning

2. MONITORING

a. Purpose. Having a person monitor the dam in the event of an impending failure, is the first step in implementing the EAP. During periods of heavy precipitation, flooding, or any unusual hydrologic event that might cause structural damage to the dam, the owner should have qualified personnel monitor the dam. The owner should assume responsibility for having the monitor at the dam within a reasonable time, and for providing an adequate communication system between the monitor and local officials.

b. Designated Monitor (to be completed by owner)

Name:
Address:
Phone: Home: (   )   -
Work: (   )   -

c. Type of Training. The owner should provide proper training so the monitor will have sufficient ability to recognize the condition of the dam, and be able to identify and evaluate specific problem areas. This training should be extensive enough to allow the monitor to describe conditions to local officials.

d. Communication System. The owner should provide primary and secondary communication systems between the dam monitor and local officials.

(1) *Primary System:* Normal telephone communication. The monitor should have access to the nearest available telephone and have on his person phone numbers of all appropriate local officials.

(2) *Secondary System:* Shortwave radio. If the phone system is out of order, the monitor should have access to a shortwave radio that can be monitored by local officials with scanners.

As an alternative to this system, if any local officials live within a short distance of the dam, the monitor could drive to one of their residences if the roads are passable.

SAFETY FIRST - Do not take chances that will jeopardize personal safety. Observe conditions at a distance if difficult or dangerous to investigate.

3. EVALUATION

a. Purpose. In conjunction with the ability to assess condition of the dam, the monitor should have the ability to determine and evaluate the nature of any existing problem. This evaluation is a crucial step, because failure to accurately and promptly identify a problem may adversely affect the EAP warning system.

b. Check List of Unusual Events or Conditions. Following is a check list of items that the monitor should use for assistance in preparing a safety assessment of the dam. The Rhode Island Emergency Management Agency should be contacted immediately if any of the following conditions are noted.

(1) Increased leakage or seepage at the toe of the embankment. This would indicate a changed condition that should be monitored.

(2) Muddy leakage or seepage which would indicate that the earth fill in the dam is piping and the toe filter is not functioning properly.

(3) Leakage or seepage in the spillway are evidence of cracking, spalling or recent dam movement and instability.

(4) Obstruction or buildup of debris on the spillway.

(5) Any other unusual or unexplained conditions.

4. PREVENTIVE ACTION

a. Purpose. This section addresses actions that the monitor can take to help prevent an overtopping failure of the Greenwich Bleachery Pond Dam.

b. Maintenance. The monitor should ensure that the spillway is kept clear of debris during normal conditions. In the event of flooding, the monitor should take reasonable steps to ensure that the spillway and sluice gate do not become blocked with debris so that it can carry its full capacity.

> **SAFETY FIRST - Do not take chances that will jeopardize personal safety. Observe water levels and other conditions at a distance if high water levels make access to the gate or dam difficult or dangerous. Do not take chances in trying to remove debris with high water conditions.**

5. WARNING

a. Purpose. If the monitor feels that possible failure of Greenwich Bleachery Pond Dam is imminent, he/she should immediately notify the Rhode Island Emergency Management Agency, or other designated contact, who in turn will contact other officials (Section C) and downstream residents (Section D), and implement a warning/evacuation plan. If possible, the monitor should return to the dam and provide continuing surveillance, and report to the emergency management officials as appropriate.

b. Dam Failure Imminent. The monitor should evaluate if Greenwich Bleachery Pond Dam is in imminent danger of failure from any of the following conditions:

(1) Masonry blocks start to fall out.

(2) Portions of the earth embankment start to wash out.

(2) Sudden or ongoing movement of the dam.

(3) Cracking or breakup of the concrete spillway

(4) Rapid development of a major leak.

c. Officials to Contact (As of December 1995). Officials at the Rhode Island Emergency Management Agency office can be reached 24 hours a day. During normal business hours, the receptionist at the office will locate the current duty officer. During all other hours the phone connects to the Rhode Island State Police Department in East Greenwich, Rhode Island, which will locate the duty officer. In the event that the phone system has failed, any Rhode Island State Police barracks or cruiser can reach the duty officer through its radio system. Any available shortwave radio or CB radio can be utilized to contact the nearest police barracks.

Mr. William Sequino Jr.
Town Manager - East Greenwich
Phone (401) 886-8665

Mr. Avis B. Gardiner
Town Clerk - East Greenwich
Phone (401) 886-8604

Ms. Judith H. Bayley
President of Town Council
Home Phone (401) 884-2862

Mr. Kenneth Ross
Chief - East Greenwich Fire Department
Phone (401) 886-8686

Mr. Lawrence Campion Jr.
Chief East Greenwich Police Department
Phone (401) 886-8627

Rhode Island Emergency Management Agency
24-Hour Duty Officer
(401) 421-7333

d. Downstream Residents. To be filled out and updated annually by Dam Owner

Name	Phone Number